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(54) Title: STABLE MIXTURES OF INCOMPATIBLE ACTIVE INGREDIENTS FOR PLANT PROTECTION (57) Abstract Preparations of a least two active ingredients wherein A) at least one of the active ingredients is more stable under aqueous alkaline conditions than under aqueous acidic conditions (type A ingredient(s)) and B) at least one of the active ingredients is more stable under aqueous acidic conditions than under aqueous alkaline conditions (type B ingredient(s)), characterized in that the preparation contains the type A ingredients in alkaline medium or as a stabilized alkaline form and contains at least one active type B ingredient adsorbed to hydrophobic silicic acids have improved storage stability.		

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Specification

Stable mixtures of incompatible active ingredients for plant protection

The invention relates to the technical field of preparations (also called "formulations" or "compositions") of active ingredients such as pesticides.

For special applications in the field of plant protection different active ingredients have to be combined in one formulation in order to obtain an optimum in biological activity. In certain cases these compounds may not be compatible, i. e. they have physicochemical properties which may lead to undesired interactions of the compounds in the formulations, or the conditions for stabilizing one of the active ingredients in a formulation against hydrolysis or other decomposition reactions are not useful for stabilizing or even destabilize the other active ingredient. In such a case it is difficult to obtain sufficient storage stability for the combination-product.

For the protection of paddy-rice against weeds a combination of a phosphoric ester with a sulfonylurea can be very efficient. The problem that has to be solved for such a combination is the incompatibility of both active ingredients during storage, especially during storage at elevated temperatures. Experimental formulations that contain a combination of a phosphoric ester such as anilofos and a sulfonylurea such as ethoxysulfuron can have decomposition-rates of more than 15% after one week storage at 50°C and more than 25% after 3 months at 40°C. Such decomposition-rates can not be tolerated for a product that has to be placed on the market; a commercial product has to be reasonably stable for at least 2-3 years, that means the active ingredients should not decompose more than 10% during that period. Experience shows, that 2-3 years storage under market-conditions in a moderate climate correspond to 3 months storage at 40°C and about 2 months storage at 50°C.

The combination of the herbicides anilofos and ethoxysulfuron covers a wide range of weeds in paddy fields and it was highly desirable to find a marketable formulation that contains both active ingredients. A preferred formulation-type is a granule for direct application, prepared by the extrusion-technique. During the extrusion-process water has to be applied which is later removed for the most part through drying of the granule. One of the more specific technical problems with this type of formulation and others is that both compounds are decomposed by hydrolysis but under different conditions.

It is known from literature that sulfonylureas are more stable under alkaline conditions. For instance, James V. Hay in Pestic. Sci. 1990, 29, 247-261 teaches:

"The rate of hydrolysis of sulfonylureas is pH-dependent. Hydrolysis occurs much more rapidly under acidic conditions. Since sulfonylureas are weak acids, at neutral or basic pH-values they exist almost exclusively in the anionic form and thus are much less susceptible to hydrolysis. In the presence of bases, alkali or alkaline earth hydroxides or carbonates, sulfonylureas form stable metal salts".

Alkaline conditions which are favourable for the stability of sulfonylureas such as ethoxysulfuron are on the other hand unfavourable for the stability of phosphoric esters such as anilofos. The hydrolysis of anilofos occurs much more rapidly under alkaline conditions. It was therefore necessary to protect the phosphoric ester against the influence of alkaline water. The above problems of preparing stable formulations are solved by the preparations according to the invention set forth below.

The instant invention relates to preparations of at least two active ingredients wherein

- A) at least one of the active ingredients is more stable under aqueous alkaline conditions than under aqueous acidic conditions (type A ingredient(s)) and

B) at least one of the active ingredients is more stable under aqueous acidic conditions than under aqueous alkaline conditions (type B ingredient(s)),

characterized in that the preparation contains the type A ingredients in alkaline medium or as a stabilized alkaline form and contains at least one active type B ingredient adsorbed to hydrophobic silicic acids.

The above term "silicic acids" includes various types of silicic acids also called "silicas" or "silica acids", in unmodified or modified form. The silicic acids can vary broadly with respect to degree of fineness or internal surface; highly dispersed grades are preferred. "Hydrophobic silicic acids" (or "hydrophobized silicic acids") differ from normal silicic acids in that they are not or hardly wettable with water. Hydrophobic silicic acids are obtained e. g. by treating the free hydroxyl groups of silicic acids with silanes such as dimethyl-dichloro-silan. Suitable hydrophobic silicic acid grades are commercially available. For the adsorption of the active ingredient(s) of type B various hydrophobic silicic acid types and grades may be applied according to the invention, e. g.

- highly dispersed hydrophobic silicic acid selected from the different[®]Sipernat types (Degussa AG, Germany), preferably[®]Sipernat D17 and[®]Sipernat D10;
- different hydrophobic[®]Nipsil-types (Nihon Silica Corp., Japan) such as[®]Nipsil SS-10, SS-20, SS-30p and SS-40;
- different hydrophobic[®]Wessalon types (Degussa AG, Germany).

The amount of hydrophobic silicic acids may vary within a broad range; the optimal amount depends on the amount of type B active ingredient.

A typical amount is between 4 and 12 percent by weight of hydrophobic silicic acids, based on the weight of the preparation.

The ratio of the amount of active ingredient B to the amount of silicic acids may vary and is e. g. in the range from 1:1 to 1:10, preferably 1:2 to 1:6 by weight.

The type A and B active ingredients are e. g. herbicides, fungicides, insecticides, acaricides, nematocides, antihelmiths, etc.,

Preferably the type A ingredients are selected from the group of sulfonylurea herbicides, and the type B ingredients are preferably pesticides from the type of phosphoric acid derivatives.

Sulfonyl ureas which may be used in the preparations according to the invention are e. g. pyrimidinyl- oder triazinylaminocarbonyl-[benzene-, pyridine-, pyrazole-, thiophene- and (alkylsulfonyl)alkylamino-]-sulfonamides. Preferred substituents at the pyrimidinyl or triazinyl ring are alkoxy, alkyl, haloalkoxy, haloalkyl, halogen or dimethylamino. Preferred substituents at the benzene-, pyridine-, pyrazole-, thiophene- or (alkylsulfonyl)alkylamino-moiety are alkyl, alkoxy, halogen, nitro, alkoxycarbonyl, aminocarbonyl, alkylaminocarbonyl, dialkylaminocarbonyl, alkyl, alkylsulfonyl, haloalkoxy, haloalkyl, alkylcarbonyl, alkoxyalkyl, (alkansulfonyl)alkylamino. Some suitable sulfonylurea are for example:

A1) Phenyl- and benzylsulfonylureas and related compounds, e. g.

1-(2-chlorophenylsulfonyl)-3-(4-methoxy-6-methyl-1,3,5-triazin-2-yl)urea
(chlorsulfuron),

1-(2-ethoxycarbonylphenylsulfonyl)-3-(4-chloro-6-methoxypyrimidin-2-yl)urea
(chlorimuron-ethyl),

1-(2-methoxyphenylsulfonyl)-3-(4-methoxy-6-methyl-1,3,5-triazin-2-yl)urea
(metsulfuron-methyl),

1-(2-chloroethoxy-phenylsulfonyl)-3-(4-methoxy-6-methyl-1,3,5-triazin-2-yl)urea
(triasulfuron),

1-(2-methoxycarbonyl-phenylsulfonyl)-3-(4,6-dimethyl-pyrimidin-2-yl)urea
(sulfometuron-methyl),

1-(2-methoxycarbonylphenylsulfonyl)-3-(4-methoxy-6-methyl-1,3,5-triazin-2-yl)-
3-methyl-urea (tribenuron-methyl),

1-(2-methoxycarbonylbenzylsulfonyl)-3-(4,6-dimethoxy-pyrimidin-2-yl)urea

(bensulfuron-methyl),

1-(2-methoxycarbonylphenylsulfonyl)-3-(4,6-bis-(difluormethoxy)pyrimidin-2-yl)urea (primisulfuron-methyl),

3-(4-ethyl-6-methoxy-1,3,5-triazin-2-yl)-1-(2,3-dihydro-1,1-dioxo-2-methylbenzo[b]thiophen-7-sulfonyl)-urea (s. EP-A-79683),

3-(4-ethoxy-6-ethyl-1,3,5-triazin-2-yl)-1-(2,3-dihydro-1,1-dioxo-2-methylbenzo[b]thiophen-7-sulfonyl)-urea (s. EP-A-79683),

3-(4-ethoxy-6-methyl-1,3,5-triazin-2-yl)-1-(2-methoxycarbonyl-5-jod-phenylsulfonyl)-urea (s. WO 92/13845)

A2) Thienylsulfonylureas, e. g. 1-(2-methoxycarbonylthiophen-3-yl)-3-(4-methoxy-6-methyl-1,3,5-triazin-2-yl)urea (thifensulfuron-methyl),

A3) Pyrazolylsulfonylureas, e. g.

1-(4-ethoxycarbonyl-1-methylpyrazol-5-yl-sulfonyl)-3-(4,6-dimethoxypyrimidin-2-yl)urea (pyrazosulfuron-methyl),

methyl 3-chloro-5-(4,6-dimethoxypyrimidin-2-ylcarbamoylsulfamoyl)-1-methylpyrazol-4-carboxylate (s. EP 282613),

methyl 5-(4,6-dimethylpyrimidin-2-yl-carbamoylsulfamoyl)-1-(2-pyridyl)-pyrazol-4-carboxylate (NC-330, s. Brighton Crop Prot. Conference - Weeds -1991, Vol. 1, 45 ff.),

A4) sulfondiamide derivatives, e. g.

3-(4,6-dimethoxypyrimidin-2-yl)-1-(N-methyl-N-methylsulfonylamino-sulfonyl)-ureas (amidosulfuron) and structural analogs thereof (s. EP-A-0151258 und Z. Pfl. Krankh. Pfl. Schutz 1990, Sonderheft XII, 489-497),

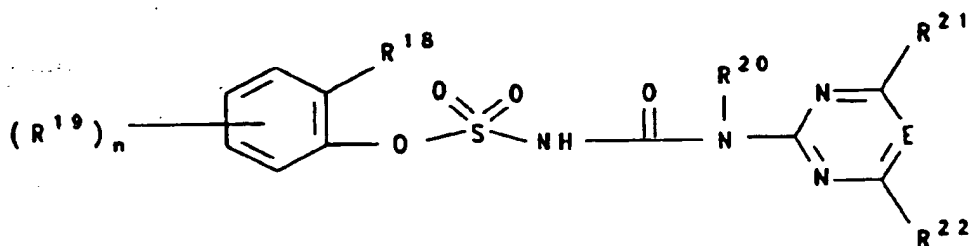
A5) pyridylsulfonylureas, e. g.

1-(3-N,N-dimethylaminocarbonylpyridin-2-yl-sulfonyl)-3-(4,6-dimethoxypyrimidin-2-yl)-urea (nicosulfuron),

1-(3-ethylsulfonylpyridin-2-yl-sulfonyl)-3-(4,6-dimethoxy-pyrimidin-2-yl)urea

(DPX-E 9636, s. Brighton Crop Prot. Conf. - Weeds - 1989, S. 23 ff.),
pyridylsulfonylureas known from DE-A-4000503 and DE-A-4030577
e. g. 3-(4,6-dimethoxypyrimidin-2-yl)-1-(3-N-methylsulfonyl-N-methylaminopyridin-2-yl)-sulfonyl-urea, or salts thereof,

A6) alkoxyphenoxy sulfonylureas such as those known from EP-A-0342569
preferably having the formula



in which

E is CH oder N, preferably CH,

R¹⁸ is ethoxy, propoxy oder isopropoxy,

R¹⁹ is halogen, NO₂, CF₃, CN, C₁-C₄-alkyl, C₁-C₄-alkoxy, C₁-C₄-alkylthio oder (C₁-C₃-alkoxy)-carbonyl, preferably in 6-position at the phenyl ring,

n is 0, 1, 2 or 3, preferably 0,

R²⁰ is H, C₁-C₄-alkyl or C₃-C₄-alkenyl,

R²¹, R²² independently of one another are halogen, C₁-C₂-alkyl, C₁-C₂-alkoxy, C₁-C₂-haloalkyl, C₁-C₂-haloalkoxy oder (C₁-C₂-alkoxy)-C₁-C₂-alkyl, preferably OCH₃ or CH₃, e. g. 3-(4,6-dimethoxypyrimidin-2-yl)-1-(2-ethoxyphenoxy)-sulfonyl-urea (ethoxysulfuron) or salts thereof,

and other related sulfonylurea derivatives and mixtures thereof.

Preferred sulfonylureas are e. g. ethoxysulfuron, amidosulfuron, metsulfuron-methyl, chlorsulfuron, thifensulfuron, chlorimuron-ethyl, bensulfuron-methyl, pyrazosulfuron-ethyl, imazosulfuron, cinosulfuron and cyclosulfamuron.

The type A compound is contained in the preparations according to the invention in an alkaline medium or as a stabilized alkaline form. The alkaline medium is e. g. an alkaline puffer system, an inorganic or organic base, optionally in the presence of an aqueous or non-aqueous solvent. A suitable stabilized alkaline form is a salt of type A compound, such as an alkali metal salt, alkaline earth metal salt, ammonium salt or a salt with an organic amine; the salt can be prepared in situ or the salt is mixed in during the process for preparing the preparation.

Preferably the type B active ingredients are selected from the group of organo-phosphorus compounds which are known as rice herbicides. Such herbicides are for instance herbicidal phosphoric acid derivatives e. g. anilofos (common name) having the chemical name S-4-chloro-N-isopropylcarbaniloyl-methyl O,O-dimethyl phosphorodithioate, piperophos or bensulide etc., preferably anilofos.

Active compounds such as those mentioned above are described, for example, in "The Pesticide Manual", 10th edition, 1994, of The British Crop Protection Council and the Royal Society of Chemistry, and literature mentioned therein.

The type of preparation according to the invention may vary broadly depending on the biological and/or chemico-physical parameters which prevail. Suitable formulation possibilities are, for example:

granules for application by scattering and to the soil, granules in the form of extruded granules, spray dried granules, absorption granules etc.

Preparations according to the invention which are of particular interest are preparations for the use in agriculture, preferably granular preparations made by the extrusion process.

These individual types of formulation are known in principle and are described, for example, in: Winnacker-Küchler, "Chemische Technologie" [Chemical

technology], Volume 7, C. Hauser Verlag Munich, 4th edition 1986, Wade van Valkenburg, "Pesticide Formulations", Marcel Dekker, N.Y., 1973; K. Martens, "Spray Drying", Handbook, 3rd edition 1979, G. Goodwin Ltd. London; J. E. Browning "Agglomeration", Chem. and Engineering 1967, pages 147 et sequ.; "Perry's Chemical Engineer's Handbook", 5th Edition, McGraw Hill, New York 1973, pages 8-57.

The necessary formulating auxiliaries, such as inert materials, surfactants, solvents and further additives, are likewise known and are described, for example, in: Watkins, "Handbook of Insecticide Dust Diluents and Carriers", 2nd edition, Darland Books, Caldwell N.J., H.v. Olphen, "Introduction to Clay Colloid Chemistry"; 2nd edition, J. Wiley & Sons, N.Y.; C. Marsden, "Solvents Guide"; 2nd edition, Interscience, N.Y. 1963; McCutcheon's "Detergents and Emulsifiers Annual", MC Publ. Corp., Ridgewood N.J.; Sisley and Wood, "Encyclopedia of Surface Active Agents", Chem. Publ. Co. Inc., N.Y. 1964; Schönfeldt, "Grenzflächenaktive Äthylenoxidaddukte" [Surface-active ethylene oxide adducts], Wiss. Verlagsgesell., Stuttgart 1976; Winnacker-Küchler, "Chemische Technologie" [Chemical technology], Volume 7, C. Hauser Verlag Munich, 4th edition 1986.

Combinations with other substances having a pesticidal action, such as, for example, insecticides, acaricides, herbicides and fungicides, and with safeners, fertilizers and/or growth regulators, can be prepared on the basis of these formulations, for example in the form of a ready-to-use formulation or as a tank mix.

The agrochemical formulations as a rule comprise 0.1 to 99 % by weight, in particular 0.1 to 95 % by weight, of active ingredients including type A and B compounds and optionally additional active ingredients. The ratio of the active ingredients of type A to type B depend on the normal application rate of the single active ingredients. With respect to the combination of anilofos and

sulfonylurea herbicides a ratio by weight of 1:200 to 1:1, preferably 1:200 to 1:2 calculated on free anilofos and free ethoxysulfuron may be useful.

The content of the phosphoric acid derivative such as anilofos in granular formulations is e. g. of from 1 to 12% by weight, preferably 3 to 6% by weight.

The content of the sulfonylurea herbicide such as ethoxysulfuron in granular formulations is e. g. of from 0.05 to 6% by weight, preferably 0.1 to 2% by weight, calculated on the free sulfonylurea rather than the salt applied.

If additional more inert active ingredients are contained in the preparation the preferred amount of the additional active ingredients depends on the utility and normal application rate of thereof. On a rule, the stability of the preparation will not be substantially effected if the amount of the more inert active ingredients is in the range of from 1 to 10% by weight of active ingredient, based on the weight of the preparation.

Preferred are granular formulations. For the preparation of preferred granules the following inerts or fillers can be used, e. g.

- carbonates of alkaline earth metals such as magnesium carbonate or calcium carbonate, preferably calcium carbonate NN #200 from Nitoh Funka Ind. Co., or
- oxides of alkaline earth metals such as magnesium oxide or calcium oxide, or
- aluminum silicate and/or magnesium silicates like Fullers earth, Florida earth, talcum or clays of different origin e.g. Neocarrier B from Asada Seifun Co.; kaolins like ®Gikuraito-MC, -AT or -PM.

As binders for the granules can be used e. g.

- bentonites like ®Kunigel V2 from Kunimine Industr. Co.; or
- salts of the alginic acid like sodium-, calcium-, -magnesium -or ammonium alginate, preferably sodium-alginate; or
- starch and dextrin; combinations of different binders may be applied.

Different types of surfactants can be used as dispersing agents for the preparation of preferred granules:

Alkali salts of oleoyl methyltaurinic acid; anionic novolak-derivatives; kresolformaldehyde-condensation products; alkyl- and alkenyl-sulfonates, like sodium-C₁₄-C₁₉-olefin-sulfonate; sodium-secondary n-alkyl-sulfonate; sodium-lauryl-sulfate; sodium-alkyl-diglycole-ether-sulfate; lignosulfonates of different origins and purification-grades like [®]Vanisperse CB (Borregard), [®]Sun X P252 (Nippon Paper Ind.) or RX-B (Takemoto).

In order to carry out the adsorption of the type B compound, the hydrophobic silicic acids are treated with the type B compounds in the presence of a suitable inert solvent, preferably a high boiling solvent which is then contained in the preparation. As high boiling solvents many different inert solvents may be used which solvents are polar enough to provide a solution of said type B compound, e.g. substituted aromatics such as [®]Solvesso-200 from Exxon Corp., SAS 296 from Nihon Sekiyu Kagaku or Solvent C₉ (Indian origin) etc.

The applied quantities of the formulation additives in the preferred granules are e. g.:

- 30 - 80% by weight (w/w) of inerts or fillers, preferably 35 - 65%;
- 10 - 40% w/w of binder, preferably 25 - 35%;
- 1 - 10% w/w of dispersing agent, preferably 2.5 - 5%;
- 2 - 10% w/w of high boiling solvent, preferably 4 - 6% ;
- 4 - 12% of hydrophobic silicic acids, preferably 6 - 10%.

Active ingredients that are more inert towards hydrolytic decomposition, like e. g. benfuresate and/or daimuron, can be added to the mixtures of active ingredients of type A and type B such as phosphoric esters and sulfonylureas. Decomposition of these more inert mixing-partners or negative influence on the sulfonylurea or the phosphoric ester is substantially avoided by the preparations according to the invention during long-term storage or storage at elevated temperatures. The content of active ingredients in a granular formulation

containing more inert active ingredients such as benfuresate and/or daimuron is for instance:

1 to 12% w/w of phosphoric ester, preferably 3.0 to 6.0% w/w;

0.05 to 6% w/w of sulfonylurea, preferably 0.1 to 2% w/w, based on free sulfonylurea and

1 to 10% w/w of more inert active ingredients, preferably 2.5 to 6% w/w.

The active ingredients benfuresate and daimuron are also known as herbicides; see "The Pesticid Manual" 10th edition, 1994, of the British Crop Protection Council and the Royal Society of Chemistry.

The process for preparing preferred granular preparations according to the invention is described in more detail in the examples and as follows.

For instance, in order to prepare a granular preparation containing anilofos and ethoxysulfuron sodium salt, a solution of anilofos in high boiling solvent can be prepared firstly and the solution is then adsorbed to hydrophobic silicic acid such as e.g. ®Sipernat D17 by using a mixer apparatus; the hydrophobic silicic acid repels water and thereby protects the phosphoric ester anilofos against hydrolytic decomposition.

The sodium salt of ethoxysulfuron is mixed with the rest of the formulation auxiliaries such as CaCO_3 and bentonite and other formulation auxiliaries. Finally the anilofos-adsorbate and the ethoxysulfuron premix are combined, and water is added up to 20% in a suitable mixer or kneader apparatus. The resulting mixture having high viscosity can then be granulated by means of extruding on an extruder, drying, crushing and sieving along common methods. Surprisingly, the resulting granular formulation is sufficiently stable even after long-term storage for years or at elevated temperatures, compared with commercial standards.

The invention thus also relates to a process for the preparation of granular preparations according to the invention wherein the type B compound adsorbed to hydrophobic silicic acids is mixed with a salt of a sulfonylurea in the presence of formulation auxiliaries and water to result in an aqueous mixture of high viscosity which mixture is then granulated.

The invention also relates to a method for stabilization of compounds which are hydrolyzable under opposite pH-conditions as defined above and which are combined in one formulation, wherein hydrophobic silicic acid is used as stabilizing adsorbent for the compound which is more stable under acidic conditions and wherein the compound, which is more stable under alkaline conditions, is contained in the formulation in an alkaline medium or as a salt.

The following examples shall illustrate the invention by specific embodiments; however the invention is not limited to the specific embodiments shown.

Example 1: anilofos not adsorbed + free ethoxysulfuron, i.e. no sodium-salt
(Comparison example)

The components defined in Table 1 are thoroughly mixed, triturated with 12-16% water, and again mixed, then extruded, dried, crushed and sieved. The mixing with water can be done in small scale in a mortar or in larger scale with a kneader. The granulation itself is carried out in laboratory scale with a small extruder ("Bench-top-basket-extruder", Tsutsui Rika Co.) and on pilot plant scale with a granulator (®Domegran Dg-L7, Fuji Paudal Co, Ltd).

Table 1

example no.	1	2	3	4	5
	content in % w/w				
ethoxysulfuron, techn.	1.0	1.0	1.0	1.0	1.0
anilofos, techn.	5.0	5.0	5.0	5.0	5.0
benfuresate, techn.	4.0	4.0	4.0	4.0	4.0
anionic novolak-derivative ¹⁾	2.0	-	-	-	-
sodium C ₁₄ -C ₁₉ -olefin-sulfonate	-	2.0	-	-	-
sodium oleoylmethyltauride	-	-	2.0	-	-
lignosulfonate	-	-	-	3.0	1.5
sodium alginate	3.0	2.5	3.0	3.0	3.0
bentonite ²⁾	20.0	22.0	20.0	30.0	30.0
Ca-carbonate	rest	rest	rest	rest	rest

Abbreviations in table 1

- % w/w = percent based on weight per weight
- rest = rest % making up to 100% of preparation
- 1) = Hoe S1728 (Hoechst), dispersing agent
- 2) = sodium montmorillonite, clay (®Kunigel V2)

The stability tests are summarized in Table 6 below. According to said stability tests examples 1-3 are not sufficiently stable after one week storage at 50°C. Examples 4 and 5 are sufficiently stable after one week at 50°C but not after three months at 40°C and 2 months at 50°C.

Example 2: anilofos adsorbed to hydrophobic silica acid + free ethoxysulfuron
(Comparison example)

2a) Preparation of anilofos powder-concentrate, 25% (anilofos-adsorbate)
1000 g of a 50% solution of anilofos in ®Solvesso 200 are adsorbed to 1000 g of hydrophobic silicic acid grade ®Sipernät D17 in a ploughshare mixer with chopper.

The use of other high boiling solvents like SAS 296 or Solvent C₉ has no adverse effect on the stability of the active ingredients. Also higher concentrated powder-concentrates up to 50% anilofos can be prepared and used successfully.

2b) Preparation of granules

The components defined in Table 2 were thoroughly mixed, triturated with 12-16% water, then extruded, dried, crushed and sieved analogously to the preparation of Example 1.

Table 2

example no.	6	7	8
	content in % w/w		
ethoxysulfuron, techn.	1.0	1.0	1.0
anilofos powder-concentrate, 25%	18.0	18.0	18.0
benfuresate, techn.	4.0	4.0	4.0
sodium C ₁₄ -C ₁₉ -olefin-sulfonate	1.5	-	-
sodium oleoylmethyltauride	-	2.5	-
sodium alkyldiglycole-ethersulfate ¹⁾	-	-	3.0
sodium alginate	1.5	1.5	1.5
bentonite ²⁾	11.5	12.0	11.5
Ca-carbonate	rest	rest	rest

Abbreviations in table 2:

% w/w = percent based on weight per weight

1) = [®]Genapol LRO (Hoechst), dispersing and wetting agent

2) = sodium montmorillonite, clay ([®]Kunigel V2)

The stability tests are summarized in Table 6 below. According to said stability tests anilofos is stable in examples 6, 7 and 8; the decomposition rate of ethoxysulfuron, however, is too high in examples 6 to 8 after one week storage at 50°C.

Example 3: anilofos not adsorbed + sodium salt of ethoxysulfuron
(Comparison example)

3a) Preparation of ethoxysulfuron-sodium salt

A suspension of ethoxysulfuron in water is stirred with the molar amount of sodium hydroxide. The water used is part of that which is needed for the extrusion-procedure. After a few minutes a clear solution is formed, which gradually changes to a suspension of ethoxysulfuron-sodium salt. The pH changes from 12 - 13 at the beginning to pH 7 at the end of the procedure. The salt-formation is completed after about 30 min. of stirring.

3b) Preparation of granules

The components defined in Table 3 were thoroughly mixed, triturated with 12-16% water, then extruded, dried, crushed and sieved analogously to the preparation of Example 1.

Table 3

example no.	9	10
	content in % w/w	
ethoxysulfuron, techn.	1.0	1.0
anilofos, techn.	5.0	5.0
benfuresate, techn.	4.0	4.0
sodium hydroxyde	molar for ethoxysulfuron	molar for ethoxysulfuron
sodium C ₁₄ -C ₁₈ -olefin-sulfonate	2.0	2.0
sodium alginate	3.0	-
bentonite	30.0	30.0
Ca-carbonate	rest	rest

Abbreviations in table 3: see Table 1

The stability tests are summarized in Table 5 below. According to said stability tests ethoxysulfuron is sufficiently stable in examples 9 and 10 after one week at 50°C but not anilofos.

Example 4: anilofos adsorbed + sodium salt of ethoxysulfuron
(According to invention)

The components defined in Table 4 and 5 and partly prepared according to examples 2a) and 3a) were thoroughly mixed, triturated with 12-16% water, then extruded, dried, crushed and sieved analogously to Example 1.

The stability tests are summarized in Table 6 further below. According to said stability tests the resulting granules are sufficiently stable at elevated temperatures. No major decomposition of the active ingredients is observed after storage for up to 3 months at 40°C or up to 2 months at 50°C.

Table 4

example no.	11	12	13	14	15	16	17
	content in % w/w						
ethoxysulfuron, techn.	1	0.2	2	1	1	1	1
anilofos powder-concentrate, 25%	18	18	18	18	18	18	18
sodium hydroxyde ¹⁾	1 m	1 m	1 m	1 m	1 m	1 m	1 m
lignosulfonate	3	3	-	3	3	3	3
sodium alkyl-diglycolethersulfate ²⁾	-	-	4	-	-	-	-
sodium alginate	3	-	2	-	-	2	1
bentonite	30	30	11	20	20	20	20
Neocarrier B ³⁾	-	-	-	-	rest	rest	rest
Ca-carbonate	rest	rest	rest	rest	30	28	29

Table 5

example no.	18	19	20	21	22	23	24
	content in % w/w						
ethoxysulfuron, techn.	0.3	0.3	0.3	0.3	0.3	0.3	0.3
anilofos powder-concentrate, 25%	18	18	18	18	18	18	18
benfuresate, techn.	4	4	4	4	4	4	4
sodium hydroxyde ¹⁾	1 m	1 m	1 m	1 m	1 m	1 m	1 m
lignosulfonate	3	3	-	3	3	3	3
sodium alkyl-diglycole-ethersulfate ²⁾	-	-	4	-	-	-	-
sodium alginate	3	-	1.5	-	-	2	1
bentonite	30	30	11.5	20	20	20	20
Neocarrier B ³⁾	-	-	-	-	rest	rest	rest
Ca-carbonate	rest	rest	rest	rest	30	28	29

Abbreviations in Tables 4 and 5

% w/w = percent based on weight per weight

1) = 1 m means 1 molar equivalent based on ethoxysulfuron

2) = °Genapol LRO (Hoechst), dispersing and wetting agent

3) = clay from Asada Seifun Co.

In Table 6, below, the decomposition-rates obtained with granules from some of the examples 1 to 24 are summarized. Table 6 shows that granules prepared from an adsorbate of anilofos to hydrophobic silicic acid and the sodium salt of ethoxysulfuron have a higher stability during storage at 40°C and 50°C than granules prepared with anilofos instead of the adsorbate of anilofos and with ethoxysulfuron instead of a salt of ethoxysulfuron.

Table 6

Example No.	percent decomposition after											
	1W 50°C		1M 40°C		2M 40°C		3M 40°C		1M 50°C		2M 50°C	
	Et.	An.	Et.	An.	Et.	An.	Et.	An.	Et.	An.	Et.	An.
1	11.8	4.8										
2	12.9	5.4										
3	14.9	9.1										
4	0	0.2	0	3.3	11.8	4.5	12.4	5.8	10.4	6.3	25.8	13.1
5	1.7	1.1	7.9	2.8	11.2	4.4	14.3	8.0	20.4	6.4	25.6	13.9
6	13.0	0.7										
7	17.9	2.1										
8	16.1	1.6										
9	0.8	5.6										
10	1.3	5.8										
11			0	2.9	2.3	2.5	5.5	2.8	0.5	5.3	9.5	7.1
12			3.8	4.2	2.8	3.2	5.7	4.8	8.1	5.6	12.9	8.1
13	0.5	0										
14			0	1.0	0	1.0	2.8	1.1	5.9	3.8	7.3	3.1
15			1.5	0.5	4.2	0.6	4.4	1.9	6.4	2.3	10.1	3.5
16			0	1.0	0	1.7	0	2.0	0	4.1	8.5	6.9
17			0.5	3.1	1.5	3.4	2.5	3.8	6.1	4.5	9.3	7.5
11			0	3.3	2.5	2.9	5.9	2.9	0.4	5.4	9.7	7.2
12	0.4	1.7	4.0	4.4	2.9	3.3	2.4	4.9	8.3	5.7	13.1	8.2
13	0.4	0										
14			0	1.2	0	0.9	2.7	0.9	6.0	3.7	7.2	3.0
15			1.6	0.8	4.4	0.6	4.2	2.1	6.3	2.5		3.6
16			0	1.2	3.4	2.6	0	1.9	0	4.0	9.3	7.0
17			2.4	2.9	0	3.6	4.4	2.5		4.7	2.0	7.8

Abbreviations in Table 5

Example no. = example no. as defined in Tables 1 to 4

Et. = ethoxysulfuron

An. = anilofos

M = month;

W = week

Patent claims

1. Preparations of at least two active ingredients wherein
 - A) at least one of the active ingredients is more stable under aqueous alkaline conditions than under aqueous acidic conditions (type A ingredient(s)) and
 - B) at least one of the active ingredients is more stable under aqueous acidic conditions than under aqueous alkaline conditions (type B ingredient(s)),characterized in that the preparation contains the type A ingredients in alkaline medium or as a stabilized alkaline form and contains at least one active type B ingredient adsorbed to hydrophobic silicic acids.
2. A preparation as claimed in claim 1 characterized by an amount between 4 and 12 percent by weight of hydrophobic silicic acids, based on the weight of the preparation.
3. A preparation as claimed in claim 1 or 2, characterized in that the weight ratio of the amount of active ingredient B to the amount of silicic acids is 1:1 to 1:10.
4. A preparation as claimed in anyone of claims 1 to 3, characterized in that the preparation is for the use in agriculture.
5. A preparation as claimed in anyone of claims 1 to 4, characterized in that the type A ingredients are selected from the group of herbicidal sulfonylureas and the type B ingredients are selected from phosphoric acid esters.

6. A preparation as claimed in anyone of claims 1 to 5, characterized in that the type B ingredient is anilofos and the type A ingredient is ethoxysulfuron.
7. A preparation as claimed in anyone of claims 1 to 6, characterized in that the preparation is a granular preparation containing
 - 0.05-6% by weight of ethoxysulfuron, based on free ethoxysulfuron,
 - 1-12% by weight of anilofos,
 - 30 - 80% by weight of inerts or fillers,
 - 10 - 40% by weight of binders,
 - 1 - 10% by weight of surfactants or dispersing agents,
 - 2 - 10% by weight of high boiling solvents,
 - 4 - 12% by weight of hydrophobic silicic acids.
8. A preparation as claimed in claim 7, characterized in that the preparation contains
 - a filler or inert material selected from carbonates of alkaline earth metals, aluminum silicates and magnesium silicates and mixtures thereof,
 - a binder selected from bentonites and salts of the alginic acid and mixtures thereof,
 - a surfactant selected from the group consisting of alkali salts of oleoyl methyltaurinic acid, anionic novolak-derivatives, kresolformaldehyde-condensation products, alkyl- and alkenyl-sulfonates, sodium-secondary n-alkyl-sulfonates, sodium-lauryl-sulfate; sodium-alkyl-diglycole-ether-sulfate and lignosulfonates.
9. A preparation as claimed in claim 7 or 8, characterized in that the preparation additionally contains 1 to 10% by weight of benfuresate.

10. A preparation as claimed in claim 7, 8 or 9, characterized in that the preparation additionally contains 1 to 10 % by weight of the active ingredient daimuron.
11. Process for the preparation of preparations as defined in claim 7, characterized in that anilofos adsorbed to hydrophobic silicic acids is mixed with a salt of a sulfonylurea in the presence of formulation auxiliaries and water to result in an aqueous mixture of high viscosity, which mixture is then granulated.
12. Method for stabilization of compounds which are hydrolyzable under opposite pH-conditions and which are combined in one formulation, wherein hydrophobic silicic acid is used as stabilizing adsorbent for the compound which is more stable under acidic conditions and wherein the compound, which is more stable under alkaline conditions, is contained in the formulation in an alkaline medium or as a salt.

INTERNATIONAL SEARCH REPORT

International Application No
PCT/EP 96/04962

A. CLASSIFICATION OF SUBJECT MATTER
IPC 6 A01N57/14 A01N25/22 //(A01N57/14,47:36,59:00,55:00,25:22)

According to International Patent Classification (IPC) or to both national classification and IPC

B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)
IPC 6 A01N

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched

Electronic data base consulted during the international search (name of data base and, where practical, search terms used)

C. DOCUMENTS CONSIDERED TO BE RELEVANT

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☒ Further documents are listed in the continuation of box C.

☒ Patent family members are listed in annex.

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INTERNATIONAL SEARCH REPORT

International Application No

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INTERNATIONAL SEARCH REPORT

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International Application No

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